

SOIL HEALTH AND NATIONAL WEALTH

How the AAA Programs Bring Better Use of Farm Land.

In view of the numerous inquiries, especially from Members of Congress, concerning soil conservation aspects of adjustment programs, the Agricultural Adjustment Administration has mimeographed a limited number of copies of the accompanying pamphlet.

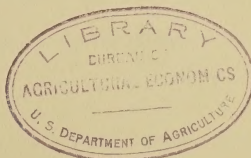
The pamphlet was prepared several weeks ago and was to have been sent to the Government Printing Office on January 6, when, however, the Hoosac Mills decision intervened.

The pamphlet shows the relationship between farm income and soil conservation practice, the many ways in which farmers long had used their adjustment programs to improve soil fertility and protect their lands against erosion, and how the two objectives of soil conservation and erosion prevention had become a fundamental principle in the plans on which the Administration had been working for many months.

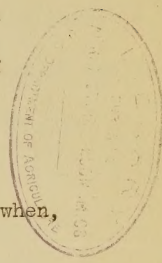
Illustrations to which reference has been made in the text had been planned for inclusion in the printed pamphlet, but obviously could not be included in this mimeographed copy.

U.S. Agricultural Adjustment Administration

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A Permanent National Soil Program

"Present and future production of supplies of food and fiber ample for this country's needs and for available export markets is a sound objective. However, there was nothing sound in the situation in the past when, spurred by ruinously low prices, farmers have been compelled to mine their soil of its fertility by over-intensive cultivation in a race to make up in volume of units what they had lost in unit price. This has resulted in waste on a colossal scale. Dust storms and mud-laden streams have been symbols of this exploitation....

"Already the adjustment programs have made important gains in conservation and restoration of soil fertility. Many millions of acres which farmers have signed contracts to divert from surplus production are being devoted to legumes, pastures, hay and other crops which fertilize the soil and protect it from blowing and washing.

"The long-time and more permanent adjustment program will provide positive incentives for soil conservation. The benefit payments can be made on a basis that will encourage individual farmers to adopt sound farm management, crop rotation and soil conservation methods. The crop insurance feature afforded by benefit payments will help farmers to maintain these beneficial systems of farming without interruption in poor crop years. Long-time adjustments can be adapted to natural soil advantages of regions and localities. Already the Adjustment Administration has under way local studies to help in working out farm programs on a county basis, so as to fit the best permanent use of the varying soil resources of the county, up to that county's share of available domestic and foreign markets. Thus, plans are being worked out that should encourage widespread cooperation of farmers in a permanent national soil maintenance program."

---President Franklin D. Roosevelt.

The Agricultural Adjustment Administration wishes to acknowledge its indebtedness to the Soil Conservation Service of the Department of Agriculture for much of the scientific material as well as several of the illustrations used in preparation of this pamphlet.

CONTENTS

FOREWORD

CHAPTER I. SAVING THE GOOD SOIL

Farm Security and the Land
When Land is Abused
What Happened in China
New "Free Lands" Replaced Abandoned Acres
Exports and Soil Losses
The End of Free Lands and Huge Exports
War Expansion, Unrepaid Loans, Depression
The Way Out for the Farmer
The Way Out for the Land
Giving Good Farming Knowledge a Better Chance
More Grass -- Healthier Soil
An Ounce of Prevention
Toward the Best Use of All Our Farm Lands

CHAPTER II. WHAT SCIENCE TELLS ABOUT THE SOIL AND ITS HEALTH

Elements Essential to Plant Life
Soil-Destroying Forces
Importance of Topsoil
Erosion is Progressive
Sheet Erosion
Gullying
Leaching
Clear Springs Versus Dirty Rivers
Floods and Drought
Dust Storms and What They Mean
Methods of Preventing Erosion
Effect of Different Types of Crops on Soil and Soil Moisture
Crop Rotation
Legumes Replenish Soil Nutrients
Terracing
Contour Cultivation
Strip Cropping
Soil Conservation and Landscape Beauty
Preventing Soil Loss by Wind
Putting Research into Practice

CHAPTER III. RESULTS UNDER ADJUSTMENT PROGRAMS

Acreage Shifted in 1934
The Trend to Grass

CONTENTS (cont'd.)

Increased Sowings of Legumes
Trend to Grass Continued in 1935
A Sample State -- Illinois
Views of Field Workers
Census and Crop Reports
What More Grass and Legumes Mean
Soil Improvement and Production Adjustment
Better Dairy and Livestock Farming
Benefits to Dairy and Livestock Producers
Benefits to Consumers
Adapting AAA Programs to the Needs of Particular Regions
Agricultural Adjustment and Erosion Control
Furthering Long-Time Aims for an Efficient Agriculture
A Positive Program of Good Land Use
Contracts for 1936 Definitely Specify Good Land Use
Encouraging Good Farm Management Practices
Importance of Continued Research
A New Chapter in the Story of American Agriculture

FOREWORD

There is widespread discussion as to the direction a long-time program for agriculture ought to take. Many persons hold the view that one of the most important considerations in any long-time program for agriculture should be conservation of soil resources. For the commercial farming regions this is closely related to sound farm management practice and beneficial systems of crop rotation. All these objectives, together with the continuing objective of increasing and maintaining farm income, can be best approached, it is felt, if the planning and administration of the agricultural adjustment programs are placed so far as possible on a local and regional basis.

This pamphlet, describing the factors which make for a sound agriculture, is intended to give a basis for consideration of long-time objectives.

Farmers who read it will, I trust, be able to make better use of the adjustment programs in which they are now participating. I think farmers will find that these programs are being so shaped as to assist them to put into effect the most efficient production practices that have been developed for their region and their type of farming.

Consumers, I believe, may gain a clearer conception of the goals toward which farmers are working, and of the interest which the entire nation has in conservation of soil wealth.

-- Chester C. Davis,
Administrator, Agricultural Adjustment Act.

SOIL, HEALTH AND NATIONAL WEALTH

How the AAA Programs Bring Better Use of Farm Lands

Chapter I.

SAVING THE GOOD SOIL

Man is a land animal. The food he eats, the clothing he wears -- the most basic necessities of his life -- come from the land.

In a simple society, most families directly use the land in securing these necessities.

In a more complex society, which has developed specialized tools and specialized occupations, only part of the people are needed to draw from the land the products required by everyone. A large proportion of people no longer have a direct relation to the land.

At the same time, the specialized machinery and intensive methods that have had to be developed to enable part of the people to produce food and fiber for all the people have greatly increased the possibility for good or ill in the use of land.

Everyone, whether engaged directly in agriculture or not, is closely affected by what happens to the land under the conditions that must be met in a modern society.

When land is used in such a way that its productivity becomes greatly diminished in relation to population, people as a whole have lower supplies of food at higher prices.

When productivity suffers through mis-use of land, the people engaged in agriculture are forced to lower standard of living.

Farm Security and the Land

But the relationship works the other way, too. When agriculture fails to return farmers a fair income, farmers may not be in a position to treat their land well.

Unquestionably it would pay a farmer over a number of years to make investments in soil conservation. On many farms, certain measures can be taken with little or no added cost and with an immediate increase in net returns.

But a farmer pressed by financial obligations, such as interest, debt, cash rental, taxes and other expenses which cannot be put off, feels the necessity to work his land to the limit in order to meet these obligations. He feels he cannot afford to plant grass or trees on his sloping fields to protect them from washing, because grass or trees may not bring an immediate cash return. He feels that he cannot afford to rest part of his land each year from intensive

production of cash crops, and plant soil-replenishing cover crops which would build up its fertility.

A farmer who, in spite of all his efforts, finds that he comes out behind every year because of low prices, will eventually lose his farm. He or some other farmer will become a renter on the same land. As a tenant and not an owner, he will then have even less incentive to practice methods of farming that conserve the land.

When Land Is Abused

The land resources of the United States are still very great in relation to the population dependent upon them. But because farmers and the nation as a whole have been more concerned with obtaining maximum production from the soil than with developing an agriculture that can treat the land well, land resources in relation to population have already been greatly diminished.

Over half the farmers who work the land are now not owners, but renters. Naturally they have somewhat less interest in keeping up the land.

Already 50 million acres of farm land have been essentially ruined because the soil has been allowed to wash away. This is an area equal to all the land in farms in the states of Illinois and Indiana. Other millions of acres have been seriously damaged.

What Happened in China

Northwestern China provides a striking example of what happens when a country continuously mis-uses its land.

There, farmers for centuries have worked the land to the limit. They cut down the trees on the slopes and uplands. They tried to put every acre into intensive crops.

The slopes and uplands could not continuously bear intensive cultivation. The rain, no longer held back by trees and grass, rushed down from the mountains. It carried the soil away. Millions of acres of sloping uplands became waste.

Millions of people had to leave the higher lands, and settle in dense hordes on the alluvial plains bordering the rivers. There the land is so intensely used that even the roots of grain crops are dug up for feed or fuel.

When rain comes, it flows rapidly over the surface of the land and into the rivers. The swollen rivers flood the bottom lands where people are densely concentrated, sometimes drowning many thousands. When the water is gone, often there is drought and famine.

The United States is far from the condition of northwestern China in its present resources and use of land. But it has been moving

in that direction at a rate probably faster than that which led to the devastation of so much of China's soil. Unless wiser methods of land use can be effected, it will continue on that disastrous road.

New "Free Lands" Replaced Abandoned Acres

One reason it seemed of little importance to consider how land was being used in the United States was because there was so much of it. As long as farmers felt that fresh new land could be had almost for the taking, they were not alarmed by the necessity of abandoning areas on which the top soil had been allowed to wash away.

The used-up land could be readily replaced with new clearings or new breakings of the prairie sod, and agriculture did not seem to be the worse off. In fact, by drawing on this great reservoir of virgin lands it was possible for a long time to increase continually the total amount of land in cultivation.

Exports and Soil Losses

Another reason it seemed unimportant to conserve the cultivated land was because, for many years, there were almost inexhaustible markets for all the products American farmers could produce on it. It paid, temporarily at least, to use the land for all it would produce.

Whereas in recent years many farmers have felt that because of low prices they could not afford to follow conservative soil practices, in the former years, when prices were high and markets were ample, many farmers did not take the trouble to guard their soil fertility.

When domestic markets had absorbed all the farm products they could take, the surplus could be shipped to European countries. European countries could pay fair prices for these products, because they had been sending the United States manufactured products needed here and lending the United States large amounts of money to promote railroads and other services needed in a young country. European nations were glad to get their money back in the form of American farm products.

Though, as the Soil Conservation Service estimates, the top soil being lost every year through washing away was worth at least 400 million dollars, it was also true that American farmers were receiving big cash returns and therefore did not worry much about this loss. They were sending abroad every year an average of 200 million bushels of wheat, 6 to 8 million bales of cotton, and 2 billion pounds of meat products. The large returns from these sales tended to obscure the loss of 400 million dollars' worth of soil through erosion, as well as the loss of fertility due to intensive cultivation.

No matter how well compensated the individual farmer might have been for his soil loss, the nation as a whole was suffering the loss of an important resource in the form of the irreplaceable layer of topsoil.

The End of Free Lands and Huge Exports

Finally, however, both these reasons for prodigal use of American farm lands disappeared or were greatly diminished.

Early in the present century most of the good new lands of the country had been taken up. Then, if used-up old lands were to be replaced, they had to be replaced by land that was no better and in many cases worse than the old land had originally been.

And by the close of the World War, there came an end to the system of exchange by which Europe could pay for American farm products with credits it had previously advanced the United States. The United States had itself loaned huge sums to European countries at war, and now found itself with a large balance of credit owing it abroad.

European nations had to get along without great imports of American farm products, or try to grow such products themselves, or obtain them from other agricultural countries with whom exchange was possible.

And with European markets greatly diminished and prices drastically reduced, there was no longer even an apparent compensation to American farmers for the damage to the soil brought about by its prodigal use in producing surpluses. A large portion of the surpluses couldn't be sold, and the extra toll sustained in their production became an outright loss.

Nor could the situation be eased by replacing costly old lands with cheap new lands. The good cheap land was already taken up.

The United States had to make an accounting of its use of land, to see where it stood in the face of limited markets and limited land resources.

War Expansion, Unrepaid Loans, Depression

This accounting was delayed for some years after the end of the War, because the United States continued to make loans to Europe which temporarily made the continued sale of goods to Europe possible.

At the same time, the accounting, when it came, was bound to be made more difficult because of the additional 50 million acres of American land that had come into cultivation through expanded War demands. Also, there were 35 million acres which formerly grew the food for millions of horses and mules, but which now were not needed because a large percentage of these animals had been displaced by automobiles, trucks, and tractors.

Since Europe had no way of repaying the new loans through sale of goods or services, their unsound nature at last became evident, and after 1930 the loans ceased. Exports of American farm products dropped accordingly. In fact it was clear that since the end of the War, farm

products sent abroad had been virtually given away, and with them, the tremendous expenditure of soil wealth used in producing them.

Depression further intensified the problem brought about by loss of foreign markets. Reduced buying power at home, with reduced outlets abroad, brought farm prices to record low levels. Surpluses increased yearly.

Farmers individually, competing with each other in a farm industry that seemed to have become some 50 million acres too large, had no way of coping with the problem. An individual farmer who wanted to reduce his acreage in cash crops had no assurance that other farms would do the same. Lacking such assurance, he felt it necessary to work his land to its maximum production, in order to try to bring his unit costs below low prices.

Thus the vicious circle continued, high production swelling surpluses to larger proportions, larger surpluses depressing prices to still lower levels, and lower prices causing farmers to make still greater use of their lands.

This was the situation facing American agriculture in 1932.

The Way Out for the Farmer

While farmers individually could not bring agriculture out of this circle of surpluses, low prices, and competitive production of cash crops on an expanded acreage, farmers working together could do it.

The problem was to move the accumulated price-depressing surpluses into consumption and to adapt the agricultural machine to post-war conditions by shifting production from unneeded surplus crops that were depleting the soil into crops that would conserve or build up the soil. If these things could be done, farm prices and farm income could be increased, and agriculture could be placed on a sound basis once more.

The first and most pressing need was that farmers be enabled to make a living and to take their place again as buyers of other products in the national economy.

Facing the problem, 3 million farmers, producers of the bulk of the nation's major crops, cooperated in programs developed by their leaders and administration officials to adjust crop acreage in line with market needs.

The adjustment steps called for in these programs were taken in 1933, 1934 and 1935. Hastened by drought, notable progress toward the first aim of the programs was made: accumulated surpluses were reduced and prices and income to farmers improved.

The Way Out for the Land

But this was not the only aim of the programs. Of equal importance, from a long-time point of view, was that American agriculture finally should recognize its trust to the land. The time was long overdue for halting the wasteful and unprofitable use of the good lands, and for putting all the land resources in better order.

These two aims, of fair returns for the farmer and of good treatment of his land, were necessarily woven together.

While some measures to control erosion can be taken by a farmer regardless of his financial status, one who is making a bare living or is in danger of losing his farm is frequently not able to use all of his land in a conservative way. He needs a little margin to go on, if he is to think of the future as well as the present, and go to the trouble and expense of keeping part of his land from intensive production and protecting the danger spots from erosion.

He will also be in a better position to practice sound methods of land use if he knows that, while he is conserving his land, other farmers are not using theirs for maximum production of commercial crops. If he can be assured that the market for the products of his farm is reasonably safe from the danger of glut by unsalable surpluses, he can turn his attention to good practices of farming rather than using his land to the limit. This will make for abundant production in the long run, but will avoid "mining" the soil for a few years and having then to abandon it.

Giving Good Farming Knowledge a Better Chance

The kinds of farming practices that keep the land of a farm in good condition year after year are not entirely unknown; they have been the object of experiment and research over many years.

In every state in the Union, agricultural scientists in the state colleges, men in the Government experiment stations, and many farmers themselves, have long been working out those methods of farming which are best suited to particular soils and climates, which will most efficiently produce suitable crops, and which will maintain the productivity of the land. Extension workers, editors of farm papers, and others have long been advocating such methods.

Too many farmers, perhaps, have looked upon soil erosion as a process of nature over which man has no control, and therefore have neglected to try to combat it.

But one of the main troubles has been that too few of the rank and file of farmers were in a position to use this accumulated knowledge to best advantage.

The adjustment programs have allowed and encouraged farmers to make use of the good farming knowledge that has long been avail-

able. Perhaps for the first time, a majority of farmers have been relieved from the intense pressure to exploit their lands to the limit, and been given an incentive to conserve their productivity.

More Grass--Healthier Soil

Adjustment programs enable a farmer to rest part of his land from intensively-tilled, soil-depleting crops, and put it in grass, clover, or other crops which replenish the soil nutrients and prevent loss of the soil from washing by rain, or from blowing by wind.

The five to thirty acres on an average farm which through the adjustment contract had been relieved from such intensive crops as cotton, tobacco, wheat, or corn, might, on a given farm, comprise a sloping or depressed part of a field in danger of erosion or gully-ing, and badly in need of permanent cover. This danger spot could be taken care of by planting trees or grass on it.

Or this acreage might be shifted from year to year among different fields, with the grasses or legumes planted on it successively building up the fertility of the various fields.

The adjustment programs not only made such beneficial uses possible; they also helped farmers to carry out such uses. The payment a farmer received for rent of this acreage helped him to buy the seed needed for soil-conserving crops, or for planting trees. More recently, the Soil Conservation Service has made its technical knowledge available and provided certain materials and services to farmers in various sections for further aid in meeting the problems on their farms. (The special function of this agency, which was set up in 1933 as an emergency agency in the Department of Interior but by an Act of Congress in 1935 was made a permanent part of the Department of Agriculture, is in the words of the Act, to "provide permanently for the control and prevention of soil erosion.")

Over the country as a whole, 36 million acres of land in 1934, and about 30 million acres in 1935 were released under the adjustment contracts from intensive production and made available for soil-protecting uses. These acres--about one out of ten of all the cultivated land of the country--are not "idle acres": they are actually being used, as various surveys show, in constructive ways that look toward the true welfare of agriculture and the nation--in conserving the soil wealth of the land.

An Ounce of Prevention ...

The great importance of a soil-conserving program of this sort on the good lands of the country lies in keeping them good--in preventing their deterioration into unprofitable lands.

Already, as has been noted, there are 50 million acres of formerly productive land which has been practically ruined because of erosion, and a much larger area that has been seriously affected.

There are also large areas of land now being farmed, which through partial erosion, through mistaken settlement, or other causes, are too poor to return farmers a decent living. The acute distress in these areas during the depression and the drought served to remind the nation of the misuses of land that have already taken place.

Dust storms dramatically brought home the fact that in some sections land had been plowed up which should have been left in grass.

Tax delinquency, bankrupt county budgets, and enormous expenditures for rural relief have impressed the nation with the fact that many farm families have been living on land too poor to return a living.

These areas of misused land have become "problem areas." Costly readjustments are required to correct the conditions that have arisen in them. Some of the land must be purchased and put to uses other than agriculture. Opportunity must be given the people living on these lands for better means of livelihood.

These readjustments will in the end return dividends in the form of better utilization of all our lands and in greater well-being of the people on the land.

But an ounce of prevention is worth a pound of cure.

The Soil Conservation Service estimates that besides the 50 million acres essentially ruined for crop use by erosion and another 50 million acres in almost as bad condition, there are now in cultivation 100 million acres of land that is seriously impaired by erosion, and another 100 million acres on which erosion has begun.

These now productive lands are potential "problem areas." The cost now in thought and cooperative effort to keep the good lands good, by wise practices of farming, is small compared to the potential cost of correcting the mistakes after the damage has been done.

Toward the Best Use of All Our Farm Lands

Thus there are two principal phases to the problem of making the best use of all our farm land resources.

One phase is concerned with correcting the mistakes in land use that have already been made. The remaining area of the public domain must be protected from further unwise settlement or overuse in grazing. Lands unfit for farming--too dry for cultivation, or too hilly, or too poor--need to be directed to better uses, as forest lands, range, recreation areas, or other uses which will provide better livelihood for people and prevent further erosion and wastage of the soil. Some of these readjustments can be made only through outright purchase by States or by the Federal government;

others may be made through zoning laws or other measures adopted by State and local governments.

A number of agencies are attempting to correct the mistakes in land use that have occurred in the past. Among these are the Soil Conservation Service and Forest Service of the Department of Agriculture, the Grazing Administration of the Department of Interior and the Resettlement Administration. Land problems are being studied by the National Resources Board and by the various State planning boards.

The other phase of the problem is concerned with conserving the productivity of the good farm lands of the country, and preventing their deterioration into "problem areas." This task, which affects the great bulk of the 360 million acres of cultivated farm land on which the welfare of the people as a whole depends, is one of the concerns of the Agricultural Adjustment Administration. In this task the Adjustment Administration is cooperating with the Soil Conservation Service, the established scientific bureaus of the Department of Agriculture, the State experiment stations, the Extension Service and other agencies concerned with good land use. The opportunity arises to bring together the scientific knowledge and methods that have been worked out in broad, related, practical programs that reach the great producing farm lands of the nation, and that will help to safeguard the productivity of these lands for future as well as present needs.

Chapter II

WHAT SCIENCE TELLS ABOUT THE SOIL AND ITS HEALTH

Principles and methods of good land use as worked out by soil and crop scientists of the various state agricultural colleges, the United States Department of Agriculture and other agencies have been utilized in shaping the agricultural adjustment programs to promote conservation of soil fertility. These principles and practices in turn are necessarily based on knowledge concerning the nature of the soil and the factors that build up or tear down soil health.

Some persons, perhaps, think of the soil as a solid, inert, lifeless mass encrusting the earth that has endured for countless ages and will endure for countless ages more.

This is a mistake. The soil is actually a dynamic substance. It has not existed forever, but was created and is continually being modified by forces acting upon and within it, slowly building it up from the parent rock of the earth, slowly making it what it is.

The original rock of the earth has been worked upon for millions of years by heat, cold, rain, wind, ice, and chemical and organic forces, which cracked, ground, dissolved, burned, upheaved, mixed, and transformed the rock material until it became the fine granular mass, partly permeated with organic material, which we call the soil.

The resulting substance is not merely "solid" or mineral. A loam soil in good condition for plant growth is, by volume, about one-fourth water, one-fourth air, and about one-tenth organic matter. In a sense, it may be said to swim, and breathe, and live.

Plants and animals, bacteria, molds, lichens, moss, algae, worms, insects, all have played and continue to play their part in mixing and investing the soil with nutrients which make it the matrix for plant growth.

Elements Essential to Plant Life

The various elements that make up the soil have their necessary functions in the growth of plants.

Nitrogen, phosphorous, potassium, calcium, magnesium, sulphur, and iron are elements found in the soil which are needed to nourish the plant. Carbon, hydrogen, and oxygen are also essential. It is further believed that certain other elements, in minute amounts, must be present in all normally fertile soils.

Organic matter, as it decays through bacterial action, is of great importance in providing the plant roots with chemical compounds of these elements in suitable forms. Water in the soil and carbon dioxide from the air furnish the carbon, hydrogen and oxygen required by the plants.

Water also dissolves plant nutrients from the minerals and makes them available to the plants, and itself provides the moisture needed for their life. Plants, like animals, can assimilate solid food only when it is in solution.

Considered together, the compounds of the various elements that compose the soil make it a porous, crumbly mass, which is yet sufficiently firm and compact to provide physical support for the plant, allowing the roots to penetrate and grasp the soil material and thus support the body and leaves of the plant that are thrust above the ground.

Above ground, through the action of light and heat, the leaves of the plant are able to take in from the air oxygen and carbon in the form of carbon dioxide (and to a small extent, nitrogen) and transform these elements chemically into the starches and sugars which make the chief foods of the plant and the cellulose which forms the basis of its cell structure.

But the soil provides the foundation and the nutrients needed to support the whole plant and make its above-ground life possible.

Soil-Destroying Forces

Because the soil is not a fixed, inert substance, but a dynamic, active one, it is readily subject to improvement or destruction, depending on the conditions affecting it.

The forces that made it are acting upon it still, and some of these forces are as capable of destruction as they are of building up the soil.

When man arrives on the scene, with his plow and cultivator and with his specialized needs, he becomes a potent factor in either helping natural forces to build up the soil, or in greatly accelerating their capacity for destroying it.

He can actually hasten nature's process of improving the soil. Careful tillage, the planting of grasses and other soil-replenishing crops, fertilization by animal or other products, may steadily improve the fertility of land. Scientists believe, for example, that the soil of England is now immensely better than it was when the Romans first appeared on the island. This has been due largely to the fact that much of the land has been kept in hay or meadows, the effect of which on the soil has been more beneficial than the original forest coverage.

On the other hand, man may in a few years destroy the work of centuries in the building of soil.

His crops may continually use up the organic and mineral nutrients of the soil without replacement.

His cultivation of the soil, in keeping large areas loose and open to sun and air for long periods of the year, may cause excessive oxidation (or slow "burning") of organic matter, depleting the soil of this necessary material.

His cultivation of slopes and hillsides, in removing the cover from the soil, may allow large quantities of the soil to be washed away into streams and rivers. His cultivation of semi-arid lands may, from time to time, allow the top soil to be blown away by wind.

This last effect of man's activity, called erosion, is by far the most rapid and serious in depleting the resources of the soil. The Soil Conservation Service estimates that it takes only about three years of tilling moderately steep slopes in the rolling Corn Belt of northern Missouri and southern Iowa to lose an inch of topsoil which had taken the slow process of nature at least four hundred years to produce. On a steep slope, the inch of top soil may be lost in one year, or even by a single rain of the "cloud-burst" type.

Importance of Top Soil

The top six or seven inches of soil is of peculiar importance not simply because it is the top layer, which the farmer can "get at," but because nature has long been preparing these six or seven inches for plant growth. It is this layer which has slowly been permeated with decayed organic matter, and made loose and workable by the action of animal and plant organisms--that is to say, properly processed by nature for healthful plant growth.

In the case of certain soil types, particularly those deposited to considerable depth by water, a high percentage of organic matter may exist through many feet of soil depth. But in the case of most soils--those formed from the parent rock or clay underneath--it is only the top layer which contains sufficient organic matter and readily available plant food for effective plant growth.

Scientists find that for these soils, which make up the large area of cultivated land, organic matter diminishes at a very rapid rate as lower levels are reached. Thus, if the soil down to six inches contains six percent of organic matter, from six to twelve inches it may contain three percent or less of organic matter, and at three to six inches it usually contains less than one percent. There is, also, less available plant food, generally, in the material beneath the topsoil.

Therefore, when the rich top layer is washed away, the fertile part of the soil is virtually gone, and the usefulness of the area for farming has been greatly diminished or essentially destroyed.

Erosion is Progressive

The damage that is caused by washing away of the soil is further increased by the fact that the loss of soil proceeds at a more and more rapid rate the longer it continues.

As inch after inch is washed away, the layers underneath ordinarily are less and less able to hold back the water and keep the soil from further washing. This is because less moisture can be absorbed by the heavier soil material underneath, and less vegetation can be grown by it to hold the soil in place.

Experiments show that on some of the most important types of agricultural land in the United States, the rate of erosion on sub-soil is from 1-1/2 to 4 times as great as the rate of erosion on surface soil.

Sheet Erosion

Sheet erosion, while the slowest form of soil-washing, is the most dangerous because it is least apparent in its initial stages and because it is the most prevalent form of erosion. It is estimated that 45 percent of the land area of the United States, exclusive of cities, has been affected in considerable degree by sheet erosion.

Sheet erosion takes place on all unprotected slopes with every rain heavy enough to cause water to flow across the fields. When the cover of grass or trees has been removed, heavy rains wash a thin sheet of the surface soil from an entire field toward its lower side, and thence into streams and onward to the sea. This slow washing of the soil is difficult to detect in its early stages, and will often not be noticed until spots of the clay sub-soil or patches of bedrock begin to show over the field.

Sheet erosion also takes place on pasture or range land which has been over-grazed to the point where the grass no longer holds the top soil in place.

Illustration 5 shows sheet erosion, which in turn is developing into gullies.

Gullying

On certain types of soil, as sheet erosion progresses, the surface water is likely to concentrate in channels, and as these channels become more defined, a more acute form of erosion begins, called gullying. (See Illustration 5).

Gullying may also be started from a depression in the field which a farmer plows across, instead of leaving it in grass, or from as small an indentation as a wheel rut or a cattle trail.

Once gullying has well started in regions where the soil is especially vulnerable, it is difficult to stop. A gully may advance either vertically or horizontally, or both, carving away the soil, deepening and widening until whole fields and even whole farming valleys are consumed in its progress. The National Resources Board estimates that, included in the 50 million acres of ruined land previously mentioned, between 25 and 30 million acres have been ruined by gullying, which is the last stage of accelerated erosion.

Illustration 6 shows an example of an advanced gully in Illinois, an encroaching menace to the farm land around it. This gully was later controlled by the Soil Conservation Service, through planting of black locust trees.

Leaching

Even when little washing away of the soil takes place, land that is intensively cultivated may lose a great deal of its fertility through the draining away of valuable mineral elements which dissolve in water. Rainfall on bare fields, loosened by cultivation, even when the fields are almost flat, may soak through soil, dissolving the mineral nutrients, and eventually carrying them into streams and rivers. This is called leaching.

Some amount of leaching is, of course, inevitable. But it is increased by practices of farming which leave a large proportion of the land bare of cover for long periods of the year, and can be decreased by greater use of grass and cover crops.

Clear Springs Versus Dirty Rivers

Muddy streams have long been telling the story of soil wastage over a wide area of the United States.

Murky, muddy streams and rivers in the South, the Middle West, and other parts of the country have so long been part of the landscape that they have been taken for granted. Few people realize that they have not always been this way, that the muddy condition of most streams is not, in a true sense, "natural".

We know from the reports of early travelers in the Prairie states that before the extensive cultivation of the land, most of the streams and rivers ran with clear water throughout all or most of the year. Such travelers reported that the dense, matted turf of the prairies hung like canopies over the banks of the streams, holding back the soil, and keeping the water clear of sediment. The streams were fed in those days largely by underground springs, rather than from surface run-off, and such surface water as came into streams flowed over grassy land, and did not collect sediment.

In the great natural cycle by which rainfall is precipitated on the land, finds its way into streams and rivers and finally to the

ocean, from whence it is once more drawn up into the clouds and again precipitated as rain; these are the two main ways that streams and rivers are fed: by springs, and by surface run-off.

Except in arid regions, the spring-fed way is the natural way for streams to obtain their water. Rain falls on land covered with trees, grass, bushes, and a spongy, absorptive and protective cover of vegetable litter. It slowly seeps down through this spongy, matted cover and finds its way into underground channels. Thence it wells up clear, through springs, into streams and rivers. It has served its function of watering the roots of plants without carrying away particles of the soil into the rivers.

When the trees and grasses and spongy litter have been removed by cultivation, however, the story is different. Rain falls on bare, loose soil. Only partially absorbed, it begins to run off over the surface of the land. As it flows over the surface, it carries particles of the top soil with it. Water and sediment flow into the streams, making them run muddy, and carrying millions of tons of soil into the ocean every year.

Floods and Drought

Instead of clear streams, fed by underground springs or by grassy runlets, and flowing relatively steadily throughout the year, surface-fed streams are alternately swollen with muddy flood waters and dry or shallow during the summer months.

This is the condition of many rivers of the United States at the present time. In great watersheds like the Ohio, Missouri, and Mississippi, it means increased danger of flood damage during the wet, spring months, and increased danger of drought and crop damage during the dryer months.

Failure of excessively cultivated lands to hold back the rainfall, therefore, means two kinds of losses. There is loss caused by too much water flowing into rivers at a given time, and this means flood damage, and tremendous loss of top-soil. It also means silted river channels and reservoirs.

There is also the loss of moisture which might have been held in the soil to mature crops during the dryer months. This loss may be disastrous in time of drought.

Soil conservation is basic, then, to flood control, and to moisture conservation as well as to the maintenance of soil wealth.

Dust Storms and What They Mean

Recurring dust storms are evidence of wasted soil resources and misused land.

Dust storms occur when land is continually cultivated in regions

where rainfall is too sparse to produce regularly an adequate growth of vegetation to protect the ground. When a period of drought arrives, as in 1933, 1934, and 1935, the topsoil which is no longer stabilized by natural grasses or cultivated crops, becomes exceedingly dry and powdery. In this condition, it is easily swept up by wind, blown in drifts of increasing size, and carried in dense clouds into the air.

The Soil Conservation Service reported that the dust storms of 1935 caused dunes twenty feet high in the Texas Panhandle, extending in some cases for a quarter of a mile across fields and fences. On thousands of acres in this area, the topsoil was removed by wind, with losses ranging from a few inches to two or three feet. In western Kansas, two dust storms were estimated to have carried away from forty to eighty tons of soil per acre over the region affected.

Methods of Preventing Erosion

A country of verdant lands, with spring-fed streams flowing clear through every season, is a beautiful picture.

It is a picture which cannot fully be realized. Civilization, for good or ill, makes demands on the land which necessarily alter its pristine character. The needs of a populous nation require breaking of the heavily-matted sod, intensive cultivation of large areas, lumbering of forests, and cutting of hills to build roads and railways.

These activities may be carried on in either a destructive or a conservative way. It would be impossible, of course, for 125 million people to live on the land and interfere as little with its natural conditions as if only the native animals or a few hunting tribes lived on it. But the needs of this number of people may be met without progressive exploitation of the land's resources. The land wealth of the United States is great enough that its present and prospective population may live upon it at a high level of existence for an indefinite period, provided the wealth of the soil is conserved as it is used.

Wastage of soil by wind and water, flood damage, and other destructive effects may be kept at a minimum by adequate control of erosion and by conservative practices of farming.

Soil-conserving practices of farming recommended by the Soil Conservation Service and cooperating State agencies include:

A sufficient proportion of farm land in grass, legumes, and other protective and replenishing crops.

Crop rotation.

Terracing.

Contour Cultivation

Strip cropping.

Cessation of clean tillage on the steeper, more erosive areas, and stabilization of these with trees or grass or other protective plants.

Effect of Different Types of Crops on Soil and Soil Moisture

For a number of years, State and Federal experiment stations in various parts of the country have been measuring the losses of soil and of moisture on slopes of certain degrees under different kinds of crops and ways of cultivation.

Here are some of the facts which are coming to light through such experiments:

At the Bethany station in Missouri, it was found that the annual soil-loss when corn is grown continuously on a typical (8 percent) slope amounted to 60 tons per acre. The loss of moisture, as immediate run-off, under these conditions amounted to 27 percent of the annual precipitation.

When a thick growing crop, alfalfa, was planted on the same soil and slope, the soil loss was only 0.2 ton per acre, and the loss of water by run-off was only 3 percent of the annual precipitation.

When timothy grass was grown, the soil loss was 0.3 ton per acre, and the water loss about 8 percent.

Thus it will be seen that alfalfa was 300 times as effective as corn in holding the soil, and grass about 200 times as effective as corn. Alfalfa was 9 times as effective as corn in conserving moisture, and grass about 3 times as effective.

Crop Rotation

Obviously not all the land can be kept continuously in grass or alfalfa. Our economic life depends on the cultivation of large areas of such crops as corn and cotton, which are planted in rows.

Yet there is land enough to keep a larger proportion of it than now is planted in soil-conserving crops, such as grass and alfalfa, and to develop systems of cropping in which row crops are varied with soil-protecting cover crops. This last practice is known as rotation.

What do we find as to loss of soil and moisture when rotation is practiced?

At the same experiment station at Bethany, Missouri, it was found that by a four-year rotation of corn, wheat, and clover, the loss of soil was reduced to a rate of about 10 tons per acre, and the loss of water to 11 percent of the annual precipitation, as compared with loss of 60 tons of soil and 27 percent of moisture when only corn was grown.

Thus it is evident that this type of rotation was 6 times as effective in conserving the soil as continuous planting of corn had been and about 2-1/2 times as much water was conserved.

Similar results have been shown in experiments with rotation systems for cotton and other major crops.

These facts make it clear that if farmers may be relieved from the economic pressure to keep every possible acre in intensive crops, such as cotton and corn, if they may be given an incentive to practice rotation and other soil-protecting methods of cultivation, the wealth of our farm lands will be greatly conserved.

Legumes Replenish Soil Nutrients

Not only do such crops as alfalfa, clover, and grass protect the soil from wastage by erosion, but, when used as cover crops and then plowed under, they help build up the fertility of the soil which has been depleted by exhaustive row crops. This process is called green-manuring.

The group of plants known as legumes is particularly effective in replenishing soil nutrients. This group includes alfalfa, cowpeas, field peas, vetch, soybeans, red clover and sweet clover, and lespedeza. . . . These plants both conserve and add to the soil nutrients, particularly the nitrates which are so valuable in plant growth. They conserve the nitrates already in the soil, and they also have the property of fixing nitrogen from the air, and hence adding to the original supply of nitrates.

It is estimated that a ton of air-dry alfalfa adds 50 pounds of nitrogen to the soil, a ton of cowpeas adds 43, and a ton of soybeans adds 53 pounds.

Terracing

Great savings of soil may be made when terraces of the American type are properly constructed on moderate slopes that are to be cultivated. Terracing of the walled or bench type has long been practiced in populous countries of Europe, where the use and conservation of every acre of soil is imperative. This European type of terracing has not been practiced in the United States. But terraces of the American type (embankments thrown up along the slope contours) have been constructed on cultivated sloping land in the United States with good results in protecting soil losses, and the practice might well be extended.

Illustration 7 pictures terraces recently constructed on a farm in Kansas.

Contour Cultivation

Still another method of tillage which, at little trouble, may effect large savings in soil and moisture is cultivation of sloping

land along the contour lines.

Contour lines are the lines which follow the surface of a slope at the same level of elevation, and cultivation along contours means plowing, cultivating and planting row crops along these lines, rather than in straight furrows across or up and down the land. Illustration 7 shows contour furrows along with terraces, and Illustration 8 also shows contour cultivation along with strip cropping.

On Marshall silt loam at an 8.4 percent slope (Clarinda, Iowa), it was found that planting of corn in rows up and down the slope resulted in a loss of 11 tons per acre of soil annually and 11.5 percent of the annual precipitation, while cultivation of corn along contour lines resulted in no measurable loss either of soil or of water.

Strip Cropping

Erosion on sloping fields can be reduced also by planting alternate bands, or strips, of close-cover crops, such as grass, small grain, sorghums, or legumes, on the one hand and of cultivated row crops, such as corn, cotton and tobacco, on the other.

Illustration 8 shows a sloping field in Wisconsin on which strips of corn have been planted alternately with strips of oats. The corn, also, has been planted along contour lines.

The loss of water and soil from the bands planted to row crops, or left fallow, is greatly reduced by the intervening strips of thick cover crops, which catch the washing soil and water, and thus protect the field as a whole.

Soil Conservation and Landscape Beauty

These methods of cultivation which conserve the soil incidentally greatly enhance the scenic aspects of farm lands. They have the effect of landscaping the area on which they are applied.

Note in the preceding illustrations how terracing, contour cultivation, and strip cropping, by faithfully following the curves of the land and by staging the declivity of slopes tend to bring out the natural shapes of the land. Compare this treatment of land with ordinary straight row cultivation which takes no notice of slopes or rounds, and its greater scenic beauty is at once evident.

There is no mystery in this any more than there is in the advantage of a modern stream-lined motor car over a cumbersome early model. In both cases better adaptation of material to its function results in improved appearance.

Illustration 4 on page (), which shows a West Virginia hillside that has long been cultivated according to soil-conserving methods, is an excellent example of the beautifying effect of good land use. Terracing, the use of trees and grass as soil-holding strips, contour cultiva-

tion, are all evident on this hillside, and total scenic effect is worth noting.

Preventing Soil Loss by Wind

Keeping lands in sub-humid or semi-arid regions from loss of soil and wind can be accomplished only by adequate cover during periods when heavy winds are likely.

Buffalo grass, blue grama, western wheat grass and other vegetation which formed the natural coverage of such areas as the Great Plains are most effective in preventing blowing of soil. Return of some areas to this natural cover is desirable, but this can be accomplished only over a long period of time. It requires planting of the grass in strips, which gradually may spread over the area.

Soil-conservation of cultivated lands in wind-blown areas is chiefly a problem of moisture conservation.

Leaving the residues of crops on the land until sufficient moisture has accumulated to insure the successful start of the next crop is one way in which the danger of wind erosion may be lessened.

When crops fail entirely, however, it becomes necessary to resort to other devices, such as contour listing, that is, deep plowing along contour lines. This practice tends to check water as well as wind erosion, and to conserve a maximum of moisture for later crops.

In general, the practices of cultivation which conserve moisture, such as terracing, contour cultivation, strip cropping, plowless fallow, and the growth of cover crops all aid in reducing erosion by wind. The looser, sandy lands which blow very easily, should never be cultivated, but restored to grass or even, temporarily, to weeds as quickly as possible.

Putting Research into Practice

These are some of the facts which research and experience have brought out concerning the soil and how it may be conserved while it is used. As has been noted, many farmers have been unable to take full advantage of this knowledge in the past. While unquestionable practices based on this knowledge would have been economically profitable to farmers in the long run, immediate pressures of finance, low prices, and the need to keep a maximum of their land in intensive cash crops have made it difficult for them to put the knowledge into practice. These were among the handicaps that made farmers feel the need for measures of economic adjustment.

Chapter III

RESULTS UNDER ADJUSTMENT PROGRAMS

The programs of agricultural adjustment, from their launching in the spring of 1933, have been concerned with good use of the land of cooperating farmers, as well as with adjustment of crop acreage in line with effective demand. Thus the AAA programs have joined with those of the Soil Conservation Service, the Forest Service, the Resettlement Administration, the State experiment stations, the Extension Service, and other agencies in dealing with the land problem. Farm leaders and administration officials recognized from the start that relieving a proportion of farm land from the soil-exhausting burden of major crop production created an unprecedented opportunity for putting this land to the soil-conserving uses which farm specialists for many years had been advocating.

Provisions were included in contracts offered the more than 3 million cooperating farmers which would insure that the acreage taken out of surplus crops would be put to beneficial uses.

The first corn-hog contract, offered farmers for the crop year 1934, authorized use of the contracted acreage (those released from corn production) only "for planting additional permanent pasture; for soil-improving and erosion-preventing crops not to be harvested; for resting or fallowing the land; for weed eradication; or for planting farm woodlots."

The first wheat contract, covering the 1933-35 period, contained similar provisions with respect to the contracted acreage.

The cotton contract for 1934-35 specified use of the rented acres only for "soil-improving crops; erosion-preventing crops; food crops for consumption by the producer on his farm; feed crops for the production of livestock or livestock products for consumption or use by the producer on his farm; or fallowing; or such other uses as may be permitted by the Secretary of Agriculture or his authorized agent."

Food and feed crops for home use were authorized on rented acres in the South, because it was recognized that the standard of farm living in this region, which contains half of the farm population of the country, might thereby be improved. The tobacco contracts carried similar provisions.

The corn-hog, cotton and tobacco contracts further specified that the total acreage planted to commercial crops on a given farm be not increased over the acreage during the base period, less the amount of the contract acreage. This meant a real net increase in the proportion of land on a given farm that would be put to less intensive uses through the adjustment contract.

Acreage Shifted in 1934

How much of the farm land of the country was actually shifted from soil-exhausting major crop production through the adjustment program?

In the 1934 crop year, the first in which the adjustment programs were in full swing, farmers agreed to shift their production on nearly 36 million acres. This was an area as large as all the acreage harvested in 1931 in the states of New York, Pennsylvania, Virginia, Ohio, and Indiana. It represented one out of every 9 acres of cultivated land in the country.

This acreage shifted from intensive major crop production was distributed through 46 states of the Union, as the accompanying table shows. The largest proportions were in the chief agricultural states, the states where agricultural land is most valuable and most worth conserving.

Farmers in Kansas, for example, shifted 2,867,000 acres from corn and wheat; in Iowa, 2,567,000 acres were shifted, mostly from corn; in Nebraska the contracted acreage was 2,253,000; in Illinois, 1,722,000 acres; and so on.

The Trend to Grass

How were these shifted acres used?

The Replacement Crops Section of the Agricultural Adjustment Administration, on the basis of cross-section surveys and the opinion of experienced observers, indicated that the 36 million acres were used in the following ways:

About a third of them were put in pasture or meadow crops, uses which, as we have noted, are particularly effective in preventing erosion and conserving moisture.

Approximately another third of these acres were used for emergency forage crops and for crops that supplied food and feed for home use.

The remainder of the "contracted acres" were either fallowed to conserve moisture and control weeds, planted to farm wood lots, or left idle. The acreage left idle was very small.

Increased Sowings of Legumes

Increased demand for legume seed, such as alfalfa, lespedeza, sweet clover, and red clover, was evidence of the trend toward soil-replenishing crops in 1934. The largest plantings on record of lespedeza and alfalfa were reported for the Southern Corn Belt and the Cotton Belt. In the Corn Belt, competent observers indicated that soybean plantings in 1934 were the largest ever made. The soy-

ESTIMATED RENTED ACRES BY STATES AND BY
COMMODITIES FROM WHICH WITHDRAWN, 1934 (1)

	CORN	WHEAT	COTTON	TOBACCO (All types)
	Contract	Contract	Contract	Contract
	Acres	Acres	Acres	Acres
Maine	-	-	-	-
New Hampshire	10	-	-	102
Vermont	-	-	-	123
Massachusetts	10	-	-	5,138
Rhode Island	-	-	-	-
Connecticut	10	-	-	11,559
New York	600	1,871	-	1,242
New Jersey	500	506	-	-
Pennsylvania	16,000	13,339	-	21,248
Ohio	465,000	92,389	-	32,332
Indiana	672,000	112,504	-	4,444
Illinois	1,570,000	151,821	-	37
Michigan	70,000	36,905	-	-
Wisconsin	159,440	2,167	-	32,861
Minnesota	571,660	128,395	-	1,700
Iowa	2,545,000	21,741	-	-
Missouri	1,090,000	105,013	145,693	2,888
North Dakota	138,700	1,521,635	-	-
South Dakota	1,025,000	543,026	-	-
Nebraska	1,854,000	399,336	-	-
Kansas	1,020,000	1,847,244	332	181
Delaware	1,850	5,505	-	-
Maryland	21,000	43,579	-	2,150
Virginia	45,000	32,114	23,440	38,272
West Virginia	10,000	4,946	-	2,324
North Carolina	32,000	3,297	499,697	184,771
South Carolina	20,000	-	712,998	28,840
Georgia	9,500	627	1,198,657	22,145
Florida	17,000	-	43,280	1,778
Kentucky	140,000	20,958	5,248	259,662
Tennessee	172,900	10,449	391,591	42,829
Alabama	30,800	-	1,287,280	91
Mississippi	3,700	-	1,467,364	-
Arkansas	39,500	272	1,312,297	29
Louisiana	5,620	-	727,679	-
Oklahoma	233,000	543,015	1,269,982	-
Texas	223,000	546,020	5,330,947	-
Montana	5,000	653,292	-	-
Idaho	1,000	147,653	-	-
Wyoming	44,000	35,885	-	-
Colorado	320,000	225,921	-	-
New Mexico	40,000	57,142	44,093	-
Arizona	900	925	62,843	-
Utah	500	31,519	-	-
Nevada	86	1,290	-	-
Washington	-	292,477	-	-
Oregon	500	127,075	-	-
California	12,300	67,633	61,760	-
Porto Rico	-	-	-	17,748 (2)
	12,655,986	7,829,986	14,585,181	696,746

35,767,899

(1) Estimated by Commodity Sections of A.A.A.

(2) Not included in totals.

beans grown in the country as a whole were used chiefly for forage.

Forage crops, originally not specified for contracted acreage in the corn-hog, wheat, and tobacco contracts, were authorized when it was evident that the 1934 drought would cause a shortage in feed crops.

Trend to Grass Continued in 1935

The adjustment contracts offered farmers for 1935 continued provisions for soil-conserving uses of the contracted acreage, with liberalized provisions for planting for forage crops in the corn-hog and wheat contracts to make up feed shortages due to the drought.

Approximately 30 million acres, or one out of 12 of the cultivated acres of the country, were shifted from exhaustive major crop production in 1935.

A Sample State -- Illinois

More detailed evidence of the way the contracted acres have been used may be gathered from studies made in a single state.

Mr. P. E. Johnson, farm management specialist at the University of Illinois, made a study of 810 farms in Illinois on which adjustment contracts were operative in 1934. He found that an average of 19.4 acres per farm was contracted acreage. He found this contracted acreage had been put to the following uses:

Use	Per cent
Alfalfa	13.9
Sweet clover	18.2
Other clovers	21.6
Soybeans and cowpeas	23.1
Timothy and red top	3.4
Other crops	6.7
Idle land	13.1

More than 75 per cent of the contracted acres on these farm was planted to legumes.

For the state as a whole, the extraordinary trend toward legumes in 1934 and 1935 is shown in figures supplied by J. C. Hackleman, extension agronomist.

In 1933, 2,368,000 acres of Illinois land had been planted to legumes. This acreage in legumes was largely the result of the educative program which had been carried on for 20 years or more by extension workers, agricultural college men, and other farm specialists.

How the adjustment programs helped to further these aims is shown by the fact that in 1934, with approximately 1,560,000 acres in

Illinois designated as contracted acreage, the acreage in legumes jumped to 3,216,000 acres or an increase of 807,000 acres.

In 1935, with adjustment programs continuing in full swing, the legume acreage in Illinois reached 3,936,000 acres, according to Mr. Hackleman, or an increase of about 56 per cent over the legume acreage in 1933.

While the increase of soil-conserving crops in Illinois during the last two years may not exactly parallel figures in other states, they indicate the general trend, and show how the adjustment programs are accelerating the adoption of good farm management practices advocated for so long by scientists and field workers.

Views of Field Workers

Agricultural specialists in other states have given similar evidence of the trend toward grass and better farming practices in their states.

Director C. G. Williams of the Ohio Experiment Station, estimating that the larger part of the contracted acreage in the state has been devoted to legumes, wrote, "I think it safe to say that the acreage devoted to alfalfa has been doubled, and that devoted to soybeans has been increased by 25 to 40 per cent."

E. B. Reynolds, chief of the division of agronomy at the Agricultural and Mechanical College of Texas wrote, "I am of the opinion that the program has actually extended better methods of farming, including rotation or changing crops on the land, the use of soil-improving crops, terracing, strip cropping, and other methods of soil conservation."

W. D. Nichols, head of the department of economics, University of Kentucky, stated: "The careful observation of our field men indicates that legumes, grasses, and emergency forage crops were planted in increased amounts, practically to the extent that the tobacco and corn acreages were decreased."

From Virginia Agricultural and Mechanical College and Polytechnic Institute, Professor T. B. Hutcheson, Agronomist, wrote: "We believe that lespedeza has increased at least 50 per cent in the tobacco and cotton sections of the State during the last 3 years. Perhaps one-half of this increase was due to the crop-adjustment program."

Similar views are expressed by scientists and field workers in other states.

Census and Crop Reports

Other available data indicate the increase in soil-conserving crops during the years the adjustment programs have been in effect.

The July 10 crop report of the Bureau of Agricultural Economics showed an increase of nearly 15 per cent in the 1935 alfalfa acreage for the whole country over 1934. This is a record annual increase. Soybean acreage during the same years increased more than 29 per cent, and lespedeza hay was planted on a 50 per cent greater acreage. Hay acreage rose from 60,740,000 to 66,096,000 acres in the two years, or by 5-1/3 million acres.

Preliminary figures of the 1935 agricultural census also show the unmistakable trend toward soil-conserving use of farm land. With reports from 29 states available at the time of writing, the figures for these states show an increase of 35 million acres in all pasture (including woodland pasture) between 1930 and 1935, or an increase of approximately 16 per cent. Woodland pasture alone increased by 8-1/2 million acres, or about 17 per cent. Acreage in hay and sorghums for forage increased by 3-1/2 million acres, or approximately 10 per cent.

What More Grass and Legumes Mean

What do these figures mean?

When it is recalled that land which is in cotton or corn loses top soil at a rate several hundred times as great as land which is in grass, alfalfa, or similar crops, it is evident that shifting millions of acres from intensive crops to pasture and legumes means a tremendous saving in the soil wealth of the nation.

Greater plantings of legumes, as noted previously, also means replenishment of the valuable plant nutrients of the soil.

Insofar as the increased proportion of legumes and grasses facilitates the practice of rotation on a given farm, it means that land used to produce commercial crops is being maintained at a higher level of fertility and value. Experiments on the Morrow Plots at the Illinois Experiment Station showed that, with net income capitalized at 5 per cent, the value of land per acre when cultivated continuously to corn was \$57, when corn and oats were rotated, it was \$79, and when corn, oats, and clover were rotated, it was \$162.

Thus the shifting of millions of acres of farm land from intensive crops to pasture and legumes represents conserved producing capacity for agriculture. It is an investment in future security. This land being maintained in soil-conserving uses is ready when needed to supply increased demand at home or abroad. It can quickly be returned to major crop production if and when such needs arise, and will be all the more productive for its period of rest from intensive use.

Soil Improvement and Production Adjustment

Objection has been raised in some quarters that measures resulting in conserved or improved fertility of the soil are in contradiction to a continued program of production adjustment. Actually, as a little

examination will show, these two phases of the farm program are correlative rather than contradictory.

Farmers for a given year may adjust their planted acreages of staple crops by any needed amount, and either up or down, depending on previous carryover and prospective needs. With such a continuing adjustment program, any improvement in efficiency of production can result in lowered production costs, rather than in the production of unsalable surpluses. The conserved fertility of the soil, by making for more efficient production, will result in higher income and standard of living for farmers, not only for the present, but for the future. It will mean that adequate food supplies for consumers are being protected at prices which will not tend to rise through higher production costs due to impoverishment of the soil.

Better Dairy and Livestock Farming

Meanwhile, this acreage that has been shifted to pasture and legumes is not merely conserving the land, it is also being used to effect a better type of farming. Producers and consumers alike are being benefited particularly by healthier and less costly dairy and livestock farming, through greater use of pasture and of roughage crops.

The annual report of O. E. Reed, Chief of the United States Dairy Bureau, stated, "The noticeable trend toward more acreage in grass and forage crops is in line with good dairy practices." Dairy cattle when fed chiefly on concentrated grains are less able to resist such diseases as tuberculosis, Bang's disease, mastitis, milk fever, and other livestock ailments than when their rations are "lightened up" by increasing the proportions of well-cured leguminous and grass hay. More pasture feeding, by keeping dairy animals in sunlight for a greater part of the time and by allowing more exercise, has also been demonstrated to lessen the danger of disease.

Benefits to Dairy and Livestock Producers

Not only is the danger of disease decreased by more pasturing and roughage, but the costs of producing meat and milk products are reduced. It has been estimated that savings up to 40 per cent in the cost of dairy and meat production can be made by substitution of forage and pasture for more concentrated feeds.

Livestock and dairy producers who have feared that increase of hay and other roughage crops would result in excessive dairy and meat animal production should note that a much greater quantity of roughage crops is needed to equal in feed value the concentrated grains that have been displaced. As pointed out by Mr. Reed in his recent report to the Secretary of Agriculture, experiments show that cows produce from 65 to 75 per cent as much butterfat when fed exclusively on good roughage as when fed so-called "full grain" rations, and 90 per cent as much when fed roughage and a half grain ration. Thus, fear of over-production of dairy products through substitution of roughage crops for grain is unfounded. At the same time, decreased costs due

to this substitution can better the economic position of dairy producers. To quote Mr. Reed again, "Since approximately three-fourths of a cow's potential production can be obtained with roughage nutrients that cost less than half as much as the grain nutrients, the wisdom of devoting the greatest possible acreage of the farm to grass and roughage is apparent." Moreover, a dairy industry based more on roughage feeding can respond more quickly to changes in demand. If demand suddenly increases, production can be stepped up by increasing the proportion of grain rations, without any increase in animal numbers.

Benefits to Consumers

A healthier and more economical type of livestock farming benefits consumers as well as producers. Experiments show that the vitamin and mineral content of milk is increased through the proper feeding of well-cured roughage, particularly legumes, and through pasturing. The danger of human diseases communicated by milk is also lessened by dairy practices which keep animals healthy.

The savings made in more economical production of milk and meat should also result in lower costs of these necessities to consumers. There is a great opportunity for an increase of these foods in the average diet. Diet studies show that the proportion of milk and meat (particularly milk) in the average diet at present is far below a desirable amount for the most healthful nutrition. Therefore, practices of farming which may reduce costs and increase consumption of milk and meat are working toward a desirable change in the dietary habits of the nation.

While the substitution of grass and roughage crops for more concentrated grain crops in the feeding of livestock requires a large area of land, the lessened costs of production and the greater degree of conservation of the land so used make such a shift practicable. The adjustment programs are furthering this transition to a more extensive, more pastoral type of farming.

Adapting AAA Programs to the Needs of Particular Regions

The shift to more grass and a more pastoral type of farming, with its consequent benefits to producers, consumers, and the land itself, is being brought about by broad readjustment of acreage on the farms of cooperating farmers. However, in the various agricultural regions, there are special problems with regard to soil conservation and farm management which may not be adequately dealt with through the crop adjustment programs as developed heretofore.

To take account of such problems, plans are being developed by Federal and State agencies to facilitate adaptation of the programs to regional needs. In the summer and fall of 1935, agricultural economists and crop and live-stock specialists in the 48 state experiment stations cooperated with the Bureau of Agricultural Economics and the Agricultural Adjustment Administration to recommend systems of farming or ranching for each of the different agricultural areas of

the country. The aim of this project was to set up such farming systems for the different areas which would check erosion and soil depletion and would bring about lower costs of production. Such data are basic to a national farm program which can be decentralized to serve the needs of every region and locality.

In the eastern Great Plains, the AAA programs are being coordinated with the work of the Forest Service in effecting measures to lessen wind erosion within the "shelter belt area."

In certain water-shed areas where erosion is a serious problem, the AAA programs are being adapted to measures taken by the Soil Conservation Service.

As the adjustment program continues, efforts are being made to work out greater flexibility of provisions and decentralization of administration, so that good farm management practices adapted to various regions, localities, and types of soil and climate may be facilitated by the programs.

Agricultural Adjustment and Erosion Control

An important way in which AAA programs are being adapted to specific needs of specific problem areas is in connection with the work of the Soil Conservation Service in setting up projects for erosion control on certain water-shed areas.

The Soil Conservation Service is making agreements with farmers in these areas whereby technical aid and certain supplies and services are given farmers for cooperation in measures to prevent erosion on their land. Such measures may include terracing, strip cropping, rotation, planting of trees on sloping land, or other measures designed to protect the land from washing and bring about the best utilization of the different parts of the farm area - that is, by treating the different kinds of land according to their specific needs and adaptability, using all known measures of erosion prevention and control suited to that particular farm. The service first maps the entire farm, showing the physical characteristics of the land; and on the basis of this map plans a practicable land-use procedure for the farm and furnishes technical supervision for executing the plan. Trees, seed, lime and other materials are supplied in whole or in part for making the necessary changes in the use of the land, after the farmer has provided his share of these and other materials. In some instances relief labor is supplied to aid in the work. In turn, the cooperating farmer agrees to adopt the modified farm plan and management practices worked out by the Soil Conservation Service in consultation with the farmer, and to maintain the farm procedures and installations for a period of five years.

Many of the farmers in these demonstration areas also have AAA contracts. Such contracts in the past have provided merely for a blanket adjustment from the base acreage of the major crop or crops, without taking into account whether the proportion of land

in such crops was large or small with reference to good land use, whether other crops on the farm were distributed in a way that would conserve the soil, and other factors of good farm management and soil conservation.

Crop adjustment programs in these areas, according to plans now worked out, will take into consideration these other factors. Representatives of the Soil Conservation Service and of the county production control committee will consult together with the farmer in arriving at allotments which are in keeping with the plans for erosion prevention and good farm management, as well as production adjustment. The cooperating farmer will participate in the benefits of the adjustment program for adopting the constructive plan worked out by the two agencies.

More than 12,000 contracts are involved at present in these areas. The program represents an important step toward meeting specific land use problems in specific farm areas.

Furthering Long-Time Aims for an Efficient Agriculture

Such measures, designed to serve the needs of particular regions, are in line with the long-time aims of the agricultural program.

These long-time aims include:

Maintaining a balanced relation between agricultural and industrial production and prices by enabling farmers to adjust production in line with market requirements.

Protecting the interests of consumers by establishing a price goal which is not above a fair exchange value for agricultural products compared with industrial products.

Helping to safeguard the resources of land by programs which not only allow but encourage conservation and good use of farm land.

The first two of these long-time aims are incorporated in the Agricultural Adjustment Act. The third, as has been noted, is a natural corollary of the first two. The interests of producers in fair prices and income and of consumers in adequate supplies at fair prices both involve the maintenance of an agricultural plant which conserves its basic capital of the land and uses it according to the best practices of farming. We have seen that this goal could not be reached by free competition of farmers on an over-expanded acreage, but that such conditions, instead, resulted in progressive misuse and destruction of land resources. Except for such soil conservation measures as do not depend on a farmer's financial status, it can be reached only as farmers, through cooperative action, are relieved from the necessity to mine their

soil in order to try to reduce production costs below low prices.

A Positive Program of Good Land Use

With the danger of an unbalanced agriculture lessened by a continuing program of agricultural adjustment, there is opportunity in future adjustment programs for positive rather than merely permissive provisions looking toward the best utilization of land. The President has recognized this opportunity in his statement of October 25, when he gave as the second chief objective of a long-time agricultural program: "to broaden present adjustment operations so as to give farmers increasing incentives for conservation and efficient use of the Nation's soil resources."

Certain modifications in the provisions of adjustment programs can facilitate approach to this objective. Among these are simplification of contracts, greater flexibility of their provisions with respect to the needs of particular farms, and decentralization of machinery to bring administration in closer alignment with local conditions and types-of-farming knowledge.

The President's statement points out what can be done toward positive good land use in a continuing farm program:

"The long-time and more permanent adjustment program will provide positive incentives for soil conservation. The benefit payments can be made on a basis that will encourage individual farmers to adopt sound farm management, crop rotation and soil conservation methods. The crop insurance feature will help farmers maintain these beneficial systems of farming without interruption in poor crop years. Long-time adjustments can be adapted to natural soil advantages of regions and localities."

Contracts for 1936 Definitely Specify Good Land Use

Progress has already been made in simplifying the adjustment programs, and directing them, in harmony with measures taken by the Soil Conservation Service, toward more positive aims of good land use. Thus the wheat contract for 1936-1939 includes the following provision for use of adjusted acreage and other land of a cooperating farmer:

"To use on this farm in each contract year in which the contract is operative, for soil improving or erosion preventing crops, pasture, fallow, forest trees, and such other purposes as the Secretary may prescribe, an acreage not less than the normal acreage devoted to such uses on this farm plus an acreage equal to the total of the adjusted acreage under this and all other contracts with the Secretary with respect to this farm."

This provision differs from similar provisions in earlier contracts in that it requires a positive increase in the acreage put to soil-conserving uses--an increase at least equal to the amount of the contracted acreage. It differs also in that it gives the farmer a

freer hand in choosing the land that should be put to erosion-preventing or similar uses. Such land is not limited to the particular area of the contracted acres, but may be chosen from all the lands not in wheat, providing only that the total acreage in such uses is increased by the amount of the contracted acreage.

Similar provisions are included in the 1936-1939 tobacco contracts, and in the corn-hog and cotton contracts. These new contracts make the constructive use of the adjusted acreages an essential part of the farmer's agreement, rather than a merely permissive part. While great increases in pasture, meadow, and soil-improving crops occurred during the previous adjustment period, it is assured that more rapid progress in constructive farming--good farm management and soil-improving practices--will result from the new contracts with their positive provisions.

Encouraging Good Farm Management Practice

Further progress toward an agriculture which encourages the best farm management practices for every region, locality, and even individual farm, taking into consideration types of soil, slope, condition of erosion, rainfall intensity and other local conditions, can be made as adjustment programs are made more flexible and as administration is decentralized.

Farmers and agricultural specialists in a given locality are aware that the "base acreage" for individual farms--that is, the acreage in a major crop during the two or three years preceding enactment of the adjustment act and used as the basis for adjustments under the programs--may or may not be the best starting point for a good farm management program for a given farm. If local committees of farmers and erosion specialists, consulting with the farmer, were able to consider all the important factors relating to a given farm, they might work out the basis for a much better farm management program from the point of view of soil conservation and efficient use of lands as well as adjustment of production.

A step in this direction has already been made in the corn-hog program for 1936-1937. Provisions have been drawn up whereby the local committeemen will recommend an "appraised acreage" for a given farm in place of the original base acreage, that takes into consideration not only the acreage in major crops during the past 3 or 4 years, but also the type of farming adapted to the farm, the amount of sloping land and the degree of slope, soil conditions, drainage, equipment, and other important factors affecting good farm management. Adjustment of production, fitting in with national objectives, will be brought about on the basis of county allotments.

Such a provision will remove injustices due to abnormally high or abnormally low "base acreages" as originally fixed. It will also work toward conservation of the soil through enabling farmers to adopt the most appropriate farm management practices for their individual farms.

Other programs have also been modified toward greater flexibility and greater local initiative. Thus, the tobacco contracts allow modification of the "allotted" acreage on a given farm to fit in with good farming practices, provided that no producer's base is reduced more than 10 percent. The wheat contracts give county committeemen authority to raise or lower the wheat base on a farm where it is as much as 25 percent below or above the average for the locality. The wheat program also allows farmers to practice regularly established rotations even when the wheat acreage may exceed the allotted acreage for a given year, provided that the average for the four-year period does not exceed the allotted acreage.

Importance of Continued Research

Development of an agriculture that seeks to use the land resources of the nation in the most efficient way, not only for today, but for tomorrow, gives added importance to farming research in every region. The knowledge that has already been accumulated by experiment stations and agricultural colleges throughout the States has a new significance as it serves to guide local committees in developing programs for their communities.

Further research needs to be done. Basic research in agricultural science, and research related to the specific problems of different areas are equally important, since a sound foundation for practical programs can be laid only on sound knowledge.

Use of a new knowledge to make agriculture more efficient can be made with all the more confidence, when it is known that, through balanced agricultural programs, every advance can be used to increase wealth and welfare, rather than to add to unneeded surpluses and unneeded expenditure of human and natural resources.

A New Chapter in the Story of American Agriculture

American agriculture has been going through a transition period.

The nation has seen the end of frontiers. No longer can men solve the problems that face them in their own communities by moving away to virgin lands.

With the end of frontiers, the period of exploitation of natural resources is also ending. Virgin timber areas are drastically limited. Good agricultural lands are settled. The nation's resources now must be used with a view to their future productivity as well as their present capacities for profit.

The nation has seen the end of unlimited export markets. This reason for prodigal use of its resources no longer exists.

It is approaching the end of population increase. Land values may not be expected to rise merely through population growth. Use of the nation's resources must be based on their continued productivity

rather than on capital increments.

All these changes mark the conclusion of an era, an era of youthful growth and expansion, vigorous, but also wasteful, with great achievements to its credit, but with many problems left unsolved.

Readjustments are required to meet these changes and problems. Though there is temporary confusion as new patterns are developed to take the place of the old, many gains are in prospect as the new conditions are faced.

In the place of expansion and carelessly exploited resources, the nation is planning for conservation and efficient use of the resources that it has.

Instead of unlimited agricultural production and greatly varying prices, the new policy calls for balanced production, and fair prices at relatively stable levels.

Instead of sending huge shipments of farm products abroad at prices which did not compensate for the loss of fertility sustained by the soil in producing them, the nation is conserving its soil resources to meet present and future needs at home, and to supply such export markets as are available at adequate prices.

All these readjustments will make for saving instead of wasting the surplus wealth of the land, for re-investing surplus wealth in improved living for the people.

These are some of the prospects in store, as the nation recognizes its trust to the land from which its wealth must come.

Policies of Plenty

"The strongest criticism which can be made of the old order of things is that it has permitted and encouraged the ruthless and rapid exploitation of our natural resources without regard to the future. Under the doctrine of free competition this country has done an extraordinary job of gutting its forests, silting up and polluting its streams, and mining its soil fertility.

"To end these processes of destruction and take measures to undo the damage that has been done is one of the principal tasks of the present generation. I believe that more persons, in and out of government, than ever before are looking to a new order in which resources may be used without being abused, in which forests may yield lumber without the forests themselves being destroyed, in which fertile farm lands may yield food and fiber without the soil fertility being lost.

"The three million farmers cooperating in agricultural adjustment programs, who are shifting some of their acres from unneeded crops that deplete the soil to other crops that conserve and build up the soil, are doing their part in the new effort to save the nation's heritage of natural resources. Their crop adjustment measures not only increase their own income and promote national recovery, but safeguard the interests of consumers of this and later generations by helping to assure plenty for both present and future needs."

-- Henry A. Wallace,
Secretary of Agriculture.

